1. An ultrasound medical treatment system comprising:

a) an ultrasound medical-treatment transducer; and

b) a controller which powers the transducer to deliver ultrasound at an ultrasound acoustic power for or beyond an in vivo treatment time to thermally ablate patient tissue in vivo, wherein the controller determines the in vivo treatment time from a function of an experimentally-determined in vitro treatment time for the transducer to deliver ultrasound at the ultrasound acoustic power for the in vitro treatment time to thermally ablate patient tissue in vitro.

2. The ultrasound medical treatment system of claim 1, wherein the in vivo treatment time is calculated from an equation substantially equivalent to the following equation:

$$time^{in\ vivo} = -\frac{\rho}{w}\ln[1-\frac{(T_{\text{threshold}}-T_o^{in\ vivo})\,w\,time^{in\ vitro}}{(T_{\text{threshold}}-T_o^{in\ vitro})\,\rho}],$$

wherein $time^{in\ vivo}$ is the in vivo treatment time to from an in vivo lesion, $time^{in\ vitro}$ is the in vitro treatment time to form an in vitro lesion, ρ is the patient tissue density, w is the blood perfusion rate, $T_{\text{threshold}}$ is the temperature threshold for tissue ablation, $T_o^{in\ vivo}$ is the initial in vivo patient tissue temperature, and $T_o^{in\ vitro}$ is the initial in vitro patient tissue temperature.

3. An ultrasound medical treatment system comprising:

a) an ultrasound medical-treatment transducer; and

b) a controller which powers the transducer to deliver ultrasound at or above in vivo ultrasound acoustic power for a treatment time to thermally ablate patient tissue in vivo, wherein the controller determines the in vivo ultrasound acoustic power from a function of an experimentally-determined in vitro ultrasound acoustic power for the transducer to deliver ultrasound at the in vitro ultrasound acoustic power for the treatment time to thermally ablate patient tissue in vitro.

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4. The ultrasound medical treatment system of claim 3, wherein the in vivo ultrasound acoustic power is calculated from an equation substantially equivalent to the following equation:

$$q^{in\ vivo} = \frac{(T_{threshold} - T_o^{in\ vivo})}{(T_{threshold} - T_o^{in\ vitro})} \frac{w\ time/\rho}{(1 - e^{-w time/\rho})}\ q^{in\ vitro},$$

wherein $q^{in\ vivo}$ is the in vivo ultrasound acoustic power (i.e., heat deposition density) to form an in vivo lesion, $q^{in\ vitro}$ is the in vitro ultrasound acoustic power to form an in vitro lesion, *time* is the same in vivo and in vitro treatment time to form a lesion, ρ is the patient tissue density, w is the blood perfusion rate, $T_{threshold}$ is the temperature threshold for tissue ablation, $T_o^{in\ vivo}$ is the initial in vivo patient tissue temperature, and $T_o^{in\ vitro}$ is the initial in vitro patient tissue temperature Celsius.

5. An ultrasound medical treatment system comprising:

a) an ultrasound medical-treatment transducer having an ultrasound emitting area; and

b) a controller having a duty cycle and powering the transducer to deliver ultrasound at or above an ultrasound acoustic power threshold to thermally ablate patient tissue in vivo, wherein the controller determines the ultrasound acoustic power threshold from an equation substantially equivalent to the following equation:

$$APO_{threshold} = F \frac{(T_{threshold} - T_b) w c_b}{2 \alpha \bar{I}_{ave} DC} \text{ Area of transducer,}$$

wherein $APO_{threshold}$ is the ultrasound acoustic power threshold to ablate patient tissue in vivo, F is a coefficient to compensate for neglected heat conduction losses in the equation and is between and including 1.05 and 1.15, $T_{threshold}$ is the temperature threshold for tissue ablation, T_b is the blood temperature in the in vivo patient tissue, w is the blood perfusion rate, c_b is the patient tissue specific heat capacity, "Area of transducer" is the ultrasound emitting area of the transducer, α is the patient tissue frequency-dependent absorption/attenuation

coefficient, $\bar{I}_{ave}$ is the intensity gain in the region where the gain is equal to or greater than a certain value p_1, and DC is the duty cycle of the controller.

6. A method for thermally ablating patient tissue in vivo comprising the steps of:

a) obtaining an ultrasound medical treatment system including an ultrasound medical-treatment transducer and a controller which powers the transducer to deliver ultrasound to thermally ablate patient tissue;

b) experimentally determining an in vitro treatment time for the transducer to be powered by the controller to deliver ultrasound at an ultrasound acoustic power to thermally ablate patient tissue in vitro;

c) determining an in vivo treatment time as a function of the in vitro treatment time; and

d) using the controller to power the transducer to deliver ultrasound at the ultrasound acoustic power for or beyond the in vivo treatment time to thermally ablate patient tissue in vivo.

7. The method of claim 6, wherein the in vivo treatment time in step c) is calculated from an equation substantially equivalent to the following equation:

$$time^{in\ vivo} = -\frac{\rho}{w}\ln[1-\frac{(T_{threshold}-T_o^{in\ vivo})\,w\,time^{in\ vitro}}{(T_{threshold}-T_o^{in\ vitro})\,\rho}],$$

wherein $time^{in\ vivo}$ is the in vivo treatment time to from an in vivo lesion, $time^{in\ vitro}$ is the in vitro treatment time to form an in vitro lesion, ρ is the patient tissue density, w is the blood perfusion rate, $T_{threshold}$ is the temperature threshold for tissue ablation, $T_o^{in\ vivo}$ is the initial in vivo patient tissue temperature, and $T_o^{in\ vitro}$ is the initial in vitro patient tissue temperature.

8. A method for thermally ablating patient tissue in vivo comprising the steps of:

a) obtaining an ultrasound medical treatment system including an ultrasound medical-treatment transducer and a controller which powers the transducer to deliver ultrasound to thermally ablate patient tissue;

b) experimentally determining an in vitro ultrasound acoustic power for the transducer to be powered by the controller to deliver ultrasound for a treatment time to thermally ablate patient tissue in vitro;

c) determining an in vivo ultrasound acoustic power as a function of the in vitro ultrasound acoustic power; and

d) using the controller to power the transducer to deliver ultrasound at or above the in vivo ultrasound acoustic power for the treatment time to thermally ablate patient tissue in vivo.

9. The method of claim 8, wherein the in vivo ultrasound acoustic power in step c) is calculated from an equation substantially equivalent to the following equation:

$$q^{in\ vivo} = \frac{(T_{threshold} - T_o^{in\ vivo})}{(T_{threshold} - T_o^{in\ vitro})} \frac{w\ time/\rho}{(1 - e^{-w time/\rho})}\ q^{in\ vitro},$$

wherein $q^{in\ vivo}$ is the in vivo ultrasound acoustic power (i.e., heat deposition density) to form an in vivo lesion, $q^{in\ vitro}$ is the in vitro ultrasound acoustic power to form an in vitro lesion, *time* is the same in vivo and in vitro treatment time to form a lesion, ρ is the patient tissue density, w is the blood perfusion rate, $T_{threshold}$ is the temperature threshold for tissue ablation, $T_o^{in\ vivo}$ is the initial in vivo patient tissue temperature, and $T_o^{in\ vitro}$ is the initial in vitro patient tissue temperature Celsius.

10. A method for thermally ablating patient tissue in vivo comprising the steps of:

a) obtaining an ultrasound medical treatment system including an ultrasound medical-treatment transducer having an ultrasound emitting area and

a controller having a duty cycle and powering the transducer to deliver ultrasound to thermally ablate patient tissue;

b) determining an ultrasound acoustic power threshold to thermally ablate patient tissue in vivo, wherein the ultrasound acoustic power threshold is determined from an equation substantially equivalent to the following equation:

$$APO_{\text{threshold}} = F\frac{(T_{\text{threshold}} - T_b)wc_b}{2\alpha \bar{I}_{\text{ave}} DC}\text{ Area of transducer,}$$

wherein $APO_{\text{threshold}}$ is the ultrasound acoustic power threshold to ablate patient tissue in vivo, F is a coefficient to compensate for neglected heat conduction losses in the equation and is between and including 1.05 and 1.15, $T_{\text{threshold}}$ is the temperature threshold for tissue ablation, T_b is the blood temperature in the in vivo patient tissue, w is the blood perfusion rate, c_b is the patient tissue specific heat capacity, "Area of transducer" is the ultrasound emitting area of the transducer, α is the patient tissue frequency-dependent absorption/attenuation coefficient, $\bar{I}_{\text{ave}}$ is the intensity gain in the region where the gain is equal to or greater than a certain value p_1, and DC is the duty cycle of the controller; and

c) using the controller to power the transducer to deliver ultrasound at or above the ultrasound acoustic power threshold to thermally ablate patient tissue in vivo.

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